

A Visual Method for Input of Uncertain Time-Oriented Data

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We present a new human-computer interface tool for allowing users to perform efficient entry of data about events in time that are associated with uncertainty. The technique allows a single “drag-and-drop” operation to specify the type of event to be recorded, the time at which the event occurred, and the user’s confidence bounds on that time. Similar methods can efficiently specify any range of values on an interval scale. The tool is implemented as a Java applet.

FUNCTION AND IMPLEMENTATION

Computer programs that reason about clinical conditions need to know what happened and when. If temporal uncertainty plays a large role in interpreting the data, then it too must be described to the program. Data entry via conventional forms is tedious and may deter even the most determined user. In a forms-based diabetes application, for example, to enter the fact that an insulin injection was taken between noon and one p.m. requires six separate actions, three of which may involve multiple keystrokes. These are entry of the injection, the start and end time of the period of uncertainty, and the three tabbing or “Enter” operations to complete each field. If pull-down lists are used instead of keyboard entry, three operations are still needed.

Using our tool, a single compound operation suffices: first the mouse button is depressed over an icon of the item to be recorded and is dragged over a clock face. If dropped at the rim of the clock face, the event is recorded as occurring at exactly the corresponding time. If the icon is dragged into the face of the clock, an arc shows an interval of uncertainty that corresponds approximately to the arc subtended by the icon; thus, as the icon is dragged toward the center of the clock face, the uncertainty increases. The user always sees a graphical depiction of both the central time of the event and the arc of uncertainty, and can adjust both by moving the icon. The action is completed when the icon is “dropped” (by releasing the mouse button). Subsequently re-selecting the icon allows it to be moved to indicate a revised time range and shows adjustment handles that permit moving the ends of the range of uncertainty independently of the central time of the event.

The GA Clock User Interface is implemented as a Java applet using Netscape’s Internet Foundation Classes (IFC) as its primary code base. The IFC

makes it easy to implement special purpose windows as well as drag and drop functionality. Three main windows comprise the overall interface: (i) the Source Window, in which icons represent various activities, (ii) the Clock Window, in which all temporal information associated with a given icon is displayed on the face of an actual clock, and (iii) a Trash Window, in which icons can be discarded.

DISCUSSION

Data entry into computer programs that support clinical practice remains a limiting step in the use of such programs. As an application of the concept of direct manipulation, our tool allows particularly efficient one-operation recording of the occurrence of events when the system needs to record a range of times during which the event took place. The range can be interpreted as a range of uncertainty for a discrete event or as a certain span of time for an extended temporal event.

If generalized to geometries other than the clock face, our tool provides data entry for any item that is described by a choice among a small number of alternatives and a range of scalar values. For example, a range of oral temperatures could be entered by moving an icon of an oral thermometer to the vicinity of a temperature scale; distance from the scale can indicate the size of the range.

ACKNOWLEDGMENTS

This work was supported in part by research contracts 1 U01 LM05877 from the National Library of Medicine and N66001-95-D-6019 from the Defense Advanced Research Projects Agency.

